

ounties. Various matters connected with the administrative arrangements between the local authorities and the Department were considered and decided.

At the instance of the Headmasters' Conference, the Headmasters' Association, the Headmistresses' Association, and the Conference of Catholic Schools, a Bill dealing with the subject of secondary education will be introduced into Parliament this Session. The Bill proposes to transfer the powers relating to secondary education now vested in the Charity Commission, the Science and Art Department, and the Education Department to one central authority under the Committee of the Privy Council on Education, and to establish local secondary education authorities to administer areas not less than those of a county or a county borough. It is contemplated that the reconstituted Education Department will consist of two sections, for secondary and primary education respectively, these two sections being under one permanent secretary, who will be advised by chief assistant secretaries in regard to each of these two chief divisions of departmental work. The Bill further provides for the registration of secondary schools according to their different types and of teachers qualified to teach. The residue under the Local Taxation (Custom and Excise) Act, 1890, is to be allocated to education, and in the case both of residue and of Imperial grants now paid through the Science and Art Department such portions as the Treasury shall determine are to be allocated to secondary education and to technical instruction respectively.

THE new buildings of Reading College, under which name the University Extension College at Reading will in future be known, were opened by the Prince of Wales on Saturday. The College was established in 1892 as a direct outcome of Oxford University Extension work. Mr. H. J. Mackinder was appointed Student of Christ Church, Oxford, his appointment being made "with a view to giving system and completeness" to the educational work of one of the University Extension centres. His services were offered to Reading, and were accepted; and, largely owing to his efforts during the past six years, the College has advanced to the position it now occupies. The first home of the College was restricted to an ancient building, formerly part of the Hospital of St. John, attached to the Abbey of Reading. The accommodation was soon found to be insufficient for the increasing number of students. Mr. Herbert Sutton, chairman of the Council, purchased the vicarage of St. Lawrence, adjoining the Hospitium, and the acquisition of this property enabled certain necessary enlargements to be made, including the building of a dairy institute. The cost of the College properties and buildings exceeds upwards of 20,000*l.*; and it was this amalgamation of old and new buildings in one central educational organisation, to be known as Reading College, that the Prince of Wales formally opened on Saturday. In responding to the toast of "The Royal Family," at the luncheon after the opening ceremony, the Prince of Wales remarked:—"In the work we have done to-day, we have inaugurated an institution which has for its object the advancement of higher education, especially in those branches more particularly connected with science, art, and agriculture. To me this is particularly interesting on account of the early associations which render it a matter of interest to know that the new College owes its inception and encouragement to the University of Oxford, and to Christ Church, my old College. The presence of the Vice-Chancellor of Oxford and of the Dean of Christ Church, as well as the attendance of many other eminent men from Oxford, is a proof of the interest they take in this movement. Let me mention that the heads of colleges and the Hebdomadal Council have satisfied themselves of the high standard of efficiency of the education in Reading College, and have agreed with great liberality to affiliate Reading College to the parent University to the extent of conferring on it the privilege of allowing students, after spending three years at Oxford and passing certain scientific examinations there, to proceed to Reading, where one year's further study in the science and practice of agriculture should count as part of their University career, and entitle them to the B.A. degree on the completion of their full course. This proposal, although supported by a large and influential University, was, on a division, rejected by two votes, the numbers being 47 to 45. The interest which I take in University Extension teaching, which now includes agriculture, leads me to hope that another year may see the adoption of the important policy advocated by the important bodies to which I have alluded, and that its provisions may be carried through the subsequent stages to render it law."

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SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 12.—"The Electrical Response of Nerve to a Single Stimulus investigated with the Capillary Electrometer." Preliminary communication. By F. Gotch, M.A., F.R.S., Professor of Physiology, University of Oxford, and G. J. Burch, M.A. (Oxon).

By means of a very sensitive capillary electrometer the authors have obtained photographic records of the electrical response in the sciatic nerve of the frog when excited by a single stimulus. The records differ in character according to the condition of the nerve. In uninjured nerve a rapid displacement of the meniscus in one direction is followed by a corresponding displacement in the other direction. In nerve which is the seat of a persistent electromotive change, whether through local injury or the passage of an appropriate polarising current, the record shows that the initial rapid displacement is succeeded by a prolonged after-effect of similar sign. The records are sufficiently pronounced to allow of the calculation of the E.M.F. of the potential difference between the electrometer contacts causing the initial displacement; this may reach as much as 0.032 volt, and attains its maximum very rapidly. In fresh nerve at 6° C. the first indications of such electrical change occur 0.002 second after the single stimulus has been applied at a distance of 30 mm. from the capillary contacts. The after-effect develops more slowly, taking from 0.006 to 0.01 second to culminate, its maximum E.M.F. is only one-tenth that of the initial change, and it subsides slowly; it is present in every nerve when one of the capillary contacts lies upon the cross section of the nerve.

"On the Magnetic Susceptibility of Liquid Oxygen." By Profs. J. A. Fleming, F.R.S., and James Dewar, F.R.S.

May 26.—"Note on the complete Scheme of Electrodynamical Equations of a Moving Material Medium, and on Electrostriction." By Joseph Larmor, F.R.S., Fellow of St. John's College, Cambridge.

This paper (in continuation of previous memoirs) undertakes in general form the exact expression of the electrodynamical relations of moving media which are polarisable, or are in motion through the æther. No foundation is available from which to investigate the modification that the ordinary equations of MacCullagh and Maxwell must then undergo, without going back to molecular theory. When that is done the crucial point in the investigation is the transition from a theory concerned with the individual molecules to a mechanical theory concerned only with the element of volume: this requires a separation between the influence of neighbouring molecules which affects only the structure of the material at that place, and the influence of the matter in general which induces polarisation and mechanical strain in the structure. It is shown that to express the influence of magnetic polarisation of the material, and also the influence of convection of electrically polarised material, these agencies must be replaced analytically by equivalent distributions of electric current. The resulting scheme of equations is wide enough to include the whole field of electrical and optical phenomena in continuous bodies, whether fixed or in motion, of which various cases are again incidentally considered.

Physical Society, June 10.—Mr. Shelford Bidwell, President, in the chair.—Dr. S. P. Thompson described and exhibited a model illustrating Max Meyer's theory of audition. Max Meyer abandons the audition theory of Helmholtz, and contends that analysis takes place in the ear otherwise than by resonance of the Corti organ. Imagine a jointed system, like a hand, to be oscillated from one end, *i.e.* from the finger-tips. A small motion affects only the top joints, but a large motion affects the whole structure. Such a structure is the membrane of the inner-ear. It widens towards one end, and is effectively damped by the contained liquid. Wave-motions of different amplitudes run along it to different distances before they are extinguished; these distances are recorded by nerves, and are thereby communicated to the Corti organ. In the model, the compound-wave to be analysed is cut out on the edge of a disc of zinc, so that, as the disc revolves, the motions are communicated to a frame-work. If the frame is thus moved through more than a certain distance, a displacement occurs which sets a second frame in motion, and so on to a third and fourth. The depth to which the motion penetrates is indicated by a series of glow-lamps connected electrically to the frames. Prof. Ayton said it had for some time past occurred to him, when consider-

ing the way in which an expert telegraph clerk reads siphon-recorder signals on a long cable, that it might be possible to analyse waves without the supposition of a resonating apparatus. The clerk interprets not so much the motions to one side or other of the zero-line, as the rate of change of velocity, *i.e.* the acceleration of the siphon. This had been recognised in the design of those relays for long cables, where the lever makes contact when the received current exceeds a certain value, and breaks contact when the current falls below a certain minimum. Messrs. Siemens had adopted a relay in which the lever was carried on the suspended coil of a D'Arsonval galvanometer by a pivot with a small amount of friction. If contact was made, the coil could, nevertheless, continue its motion in a given direction. If that direction altered, contact was immediately broken, and the lever passed over to the opposite stop, thereby reversing the local circuit. It was possible that, in the process of hearing, something akin to this took place, the ear behaving as a mechanism responsive, not by resonance to the complete waves, but by its sensitiveness to changes of direction of the received impulses. Dr. S. P. Thompson thought that a mechanism similar to the relay described by Prof. Ayrton was contained in the telautograph of Elisha Gray; it was a "Prony" mechanism. In the acoustical problem the ear was probably sensitive to abrupt changes of shape in the waves as well as to reversals. In the case of mistuned octaves, something is heard that suggests "revolving" in the ear, indicating a cyclic change. In this regard it was necessary to take into account the phase-relations as well as the relative intensities of the component tones.—Mr. E. H. Barton then read a paper on the attenuation of electric waves along a line of negligible leakage. It forms a sequel to a paper communicated to the Physical Society and printed in their *Proceedings* of December 1897 and January 1898. Shortly after the publication of the earlier results, Mr. Oliver Heaviside drew attention to Lord Rayleigh's high-frequency formula for the "effective resistance" of wires to alternating currents, and suggested that the formula might be approximately applicable to the case; but he thought the experimental value of the attenuation would be considerably higher than the one derived from calculations. Mr. Barton here repeats the work, with special precautions as to the mode of insulating the parallel copper wires through which the wave-train proceeds. The value of the attenuation constant deduced from these experiments is 0.000013. By applying Lord Rayleigh's formula for the effective-resistance of the circuit, and using this value in Mr. Heaviside's expression for the attenuation, the calculated constant is 0.0000062. To account for the discrepancy, the author points out that the effective-resistance formula was originally developed for a wire placed at a considerable distance from other parts of the circuit, and for currents following the harmonic law. Whereas, in the experiments the conditions are (1) wires 1.5 mm. diameter, only 8 centim. apart, and (2) the waves are propagated in the form of a damped train, with the large end leading; they are extinguished after ten or a dozen vibrations. Mr. Oliver Heaviside (communicated) pointed out that, as there was human interest in error, it might be worth mentioning that at first it was supposed the previous experiments of Dr. Barton made the index of the attenuation factor to be six times that of the long-wave theory for simple periodic waves. And it was hard to account for so large a discrepancy. The discovery of an error in the figures, reduced the result from six to two. The small depth of the surface-layer of effective conduction, and the distance apart of the wires, seemed now to make it improbable that Dr. Barton's first reason (1) was adequate to account for the doubling of resistances. The second (2) was of course a substantial reason for increased resistance. A third one, Mr. Heaviside suggested, was the external resistance at the boundary of the waves. A combination of the second and third reasons, with a little of the first, might account for most of the extra attenuation observed, and, if more was wanted, one could "try the K.R. law." Mr. Appleyard said it was rather to be regretted that, in all the experiments, the distance between the wires had been the same, *i.e.* 8 cms. By taking a few different values (1) might have been checked. Lord Rayleigh's formula for the effective-resistance, involved the square-root of the magnetic permeability of the wires. The author had, throughout, used copper, a paramagnetic metal, and had assumed $\mu = 1$. It would be of advantage to try other metals. Mr. Barton, in reply, said he would make further experiments with the two

conductors at different distances apart, and he would also try iron wires. With iron, the thickness of the surface-layer of the effective conductor was about one-thirteenth that of copper. Iron should therefore give a greater value of the attenuation than copper.—Mr. A. Griffiths then read a paper on diffusive convection, a phenomenon analogous to caloric convection. The differences of density that produce convection-currents are not due to changes of temperature, but to variations in the quantity of dissolved substance per unit volume. The author has devised an apparatus consisting of a vessel divided horizontally by a diaphragm, through which pass two vertical tubes of unequal lengths. A solution of copper-sulphate, maintained at constant strength, is placed in the lower compartment. The upper compartment is filled with water. Diffusion takes place up the tubes. One tube is 4 cm. long; the other is 4.05 cm. The tops of the tubes are exactly at the same level. Up the longer tube, and down the shorter, diffusive convection occurs at the rate of 5 cm. per year. This flow *increases* the quantity of copper-sulphate transmitted by the long tube by about 2 per cent., and *diminishes* that transmitted by the shorter tube by about the same amount. Consequently, the resultant increase due to the motion is only a fraction of 1 per cent. To detect the flow, the author employs a second piece of apparatus, in which the upper ends of the tubes are separated by a capillary, containing coloured liquid. By this means the motion is considerably magnified. Dr. S. P. Thompson asked whether, in a case where a large tube was used in determining the velocity, the viscosity of the liquid would not play a very much less part than with narrow tubes. Mr. Griffiths explained that viscosity was not important until very small tubes were considered, *e.g.* those of the order 0.001 mm. diameter.—The President proposed votes of thanks to the authors, and to Dr. Max Meyer for lending the Society his model.—The meeting then adjourned until June 24.

EDINBURGH.

Mathematical Society, May 13.—Mr. J. B. Clark, President in the chair.—The following papers were read:—On the second solutions of Lamé's equation, by Mr. Lawrence Crawford (communicated by Mr. J. W. Butters); on the insulation of a sun of sensible magnitude, by Mr. A. Ritchie Scott; the singular solutions of a certain differential equation of the second order, by Mr. Hugh Mitchell.

PARIS.

Academy of Sciences, June 6.—M. Wolf in the chair.—New photographic studies of the surface of the moon, by MM. Lœwy and Puiseux. A discussion of the data contained in the third part of the photographic atlas of the moon.—On a new absolute electrodynamometer, by M. Marcel Deprez. In the system described, the forces due to the action of the current are simple algebraic functions, rigorously and without approximation, of the dimensions of the fixed and movable circuits.—On a new constituent of the atmosphere, by MM. William Ramsay and Morris W. Travers (see *NATURE*, p. 127). M. Berthelot observed that the green ray of krypton coincided almost exactly with the bright green line of the aurora borealis. He suggested the name *cosium* for the new element.—On the propagation and deformation of the tidal wave which ascends rivers, by M. Partiot. The curve of the experimental results obtained on the Gironde and Garonne are compared with five formulæ; of these, that suggested by M. Boussinesq agrees best with the experiments.—On surfaces of total constant curvature, by M. C. Guichard.—On the systems of differential equations which satisfy the quadruply periodic functions of the second species, by M. Martin Krause.—On discontinuous functions which are allied to continuous functions, by M. R. Baire.—On the determination of the order of interference fringes, by MM. A. Perot and Ch. Fabry.—On the rotatory power of quartz in the infra-red, by M. R. Dongier. A comparison of the experimental results with those calculated from a formula given by M. Carvallo.—On the discharge of a Leyden jar, by M. R. Swygedauw.—Comparison of the Hertzian field in air and in oil, by M. Albert Turpain. In a resonator kept in a plane-perpendicular to the direction of the wires the wave-lengths vary with the nature of the dielectric; if the resonator is in the same planes as the wires, the wave-lengths are independent of the nature of the dielectric.—On resonators, by M. Oudin. The resonator now used consists of a solenoid of bare copper wire wound round a cylinder of paraffined wood, the high frequency current being produced by the arrangements of Hertz, of Tesla, or of

d'Arsonval. This resonator creates a very intense alternating field, a Geissler tube being lit up at two metres distance. The discharge resembles in appearance that of a statically charged body, and causes lesions of the skin similar to those produced by the X-rays.—Visibility of the blind spot in the retina, by M. Aug. Charpentier. The experiments cited show that the spot where the optic nerve enters the retina, although insensible to light and blind in the proper sense of the word, is really represented in space by positive visual sensations occupying the same place, as if it were replaced in the eye by a real piece of retina in continuity with the rest of the membrane.—Quality of the fifteen vowels of the French language, by M. Monoyer.—Action of ammonium persulphate upon the silver in photographic negatives and the utilisation of this action, by MM. Lumière and M. Seyewetz. By means of a 5 per cent. solution of ammonium persulphate it is possible to reduce an over-exposed photograph in a manner not possible with the reagents previously suggested for this purpose, the persulphate acting first upon the most opaque portions of the negative, and leaving the half-shadows untouched.—On the causes of the imperfections in radiographs brought about by the use of reinforcing screens, by M. A. Londe. Comparative photographs were made with five screens, the platinoeyanide of barium and of potassium, sulphide of zinc, Becquerel's violet sulphide, and Kahlbaum's screen. Whilst some of these increased the rapidity of action of the X-rays, it was always at the expense of clearness of definition, the image being accompanied by a kind of halo. Hence these screens cannot be employed in delicate work.—On the constitution of the ternary alloys, by M. Georges Charpy. A microscopical study of the bismuth-lead-tin and copper-tin-antimony alloys.—On the yttrium earths contained in the monazite sands, by M. O. Boudouard.—On the carbonic acid of the atmosphere, by MM. Albert-Levy and H. Henriet. The differences occasionally observed between the amounts of atmospheric carbon dioxide as determined by potash and baryta respectively, may possibly be due not to a different absorptive power for the gas with the two reagents, but to a slow oxidation of the organic matter present in the air which proceeds with different velocities in the two cases.—On a crystallised hepta-acetate of ouabaine, by M. Arnaud. Obtained by the action of acetic anhydride in presence of zinc chloride upon ouabaine.—On some acetals of pyrocatechol, by M. Ch. Moureu.—Nitration of cellulose and its hydroxy- and oxy-derivatives, by M. Léo Vignon.—A new mucin extracted from an ovarian cyst, by M. Charles Lepierre.—On the Holothuria collected by the *Travailleur* and *Talisman*, by M. Rémy Perrier.—On the embryogeny of *Serpula infundibulum* and *Hydroides pectinata*, by M. Albert Soulier.—Polymorphism in an Annelid (*Dodecaceria concharum*), by MM. Félix Mesnil and Maurice Caullery.—On the sexuality and relations of the Sphacelariaceæ, by M. C. Sauvageau.—On the palæozoic layers on the southern declivity of the Montagne-Noire, by M. J. Bergeron.—Characteristics of the bituminous schist of the Bois-d'Asson (Basse-Alpes), by M. C. Eg. Bertrand.—On the transport of the sick, by M. Bonnafy. A discussion of the relative merits of State hospital-transports or ships chartered from the mercantile marine for this purpose.

DIARY OF SOCIETIES.

THURSDAY, JUNE 16.

ROYAL SOCIETY, at 4.30.—Observations on Stomata: Francis Darwin, F.R.S.—Note on the Attenuation and Exaltation of the Virulence of the Organism of Texas Fever: A. Edington.—Mathematical Contributions to the Theory of Evolution. V. On the Reconstruction of the Stature of Prehistoric Races: Prof. K. Pearson, F.R.S.—On some Expressions for the Radial and Axial Components of the Magnetic Force in the Interior of Solenoids of Circular Cross Section: C. Coleridge Farr.—On the Source of the Röntgen Rays in Focus Tubes: A. A. C. Swinton.—On the Constituents of Argon: Prof. W. Ramsay, F.R.S., and M. W. Travers.—And other Papers.

LINNEAN SOCIETY, at 8.—Observations on the Seasonal Variations of Elevation in a Branch of Horse-Chestnut Tree: Miller Christy.—On Pantopoda collected by Mr. W. S. Bruce in Franz-Josef Land: G. H. Carpenter.—Morphological Relationships of the Actiniaria and Madreporaria: J. E. Duerden.—On some Fossil Leporines: Dr. C. I. Forsyth Major.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows.—Preparation of a Standard Acid Solution by Direct Absorption of Hydrogen Chloride: Dr. G. T. Moody.—Researches on the Terpenes. III. Halogen Derivatives of Fenchene and their Reactions. IV. On the Oxidation of Fenchene: J. A. Gardner and G. B. Cockburn.

SATURDAY, JUNE 18.

GEOLOGISTS' ASSOCIATION (London Bridge, L.B.S.C.), at 12.25.—Excursion to Crowborough. Directors: G. Abbott and R. S. Herries.

MONDAY, JUNE 20.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Tirah: the Geographical Results of the Recent Afridi Campaign: Colonel Sir T. Hungerford Holdich.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Aluminium as a Heating and Reducing Agent (in the Production of Chromium and other Metals): Dr. Hans Goldschmidt and Mr. Claude Vautin.

VICTORIA INSTITUTE, at 4.30.

TUESDAY, JUNE 21.

ZOOLOGICAL SOCIETY, at 8.30.—Remarks upon Series of Specimens of Lepidosiren and other Fishes obtained in Paraguay: J. Graham Kerr.—Report on the Collection of Fishes made by Mr. J. E. S. Moore in Lake Tanganyika during his Expedition 1895-96; with an Appendix by Mr. J. E. S. Moore.—On the Scorpions, Spiders, and *Solpuga* collected by Mr. C. Steuart Betton in East Africa between Mombasa and Uganda: R. I. Pocock.

ROYAL STATISTICAL SOCIETY, at 5.—Annual General Meeting.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Photographic Images: Captain W. de W. Abney.

WEDNESDAY, JUNE 22.

GEOLOGICAL SOCIETY, at 8.—Post-Glacial Beds exposed in the Cutting of the New Bruges Canal; T. Mellard Reade.—High-level Marine Drift at Colwyn Bay: T. Mellard Reade.—Observations on the Geology of Franz Josef Land: Dr. Reginald Koettlitz.—Notes on Rocks and Fossils from Franz Josef Land brought home by Dr. Koettlitz, of the Jackson-Harmsworth Expedition, in 1897: E. T. Newton, F.R.S., and J. J. H. Teall, F.R.S.—On the Corallian Rocks of Upware: C. B. Wedd.

FRIDAY, JUNE 24.

PHYSICAL SOCIETY, at 5.—Exhibition of an Apparatus illustrating the Action of Two Coupled Electric Motors: Prof. Carus-Wilson.—Exhibition of Weodon's Expansion of Solids Apparatus: J. Quick.—On the Theory of the Hall Effect in a Binary Electrolyte: Dr. F. G. Donnan.

SATURDAY, JUNE 25.

GEOLOGISTS' ASSOCIATION (Liverpool Street Station, G.E.R.), at 9.30 a.m.—Excursion to Sudbury. Director: Dr. J. W. Gregory.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Grundriss der Vergleichenden Anatomie der Wirbelthiere: Prof. R. Wiedersheim, Vierte, Gänzlich Umgearbeitete Auflage (Jena, Fischer).—The Wonderful Century: A. R. Wallace (Sonnenschein).—Royal University of Ireland Exam. Papers, 1897 (Dublin, Ponsobny).—University Extension College, Reading, Calendar 1897-98, 3rd edition (Reading).—The Cubomedusæ: F. S. Conant (Baltimore, Johns Hopkins Press).

PAMPHLETS.—Lessons in Domestic Science: E. R. Lush, Part 1 (Macmillan).—The Romanes Lecture, 1898: Types of Scenery and their Influence on Literature: Sir A. Geikie (Macmillan).

SERIALS.—Zeitschrift für Wissenschaftliche Zoologie, lxxiii. Band, 4 Heft (Leipzig).—Physical Review, February, March, April (Macmillan).—Die Vertheilung der Erdmagnetischen Kraft in Österreich-ungarn: Prof. J. Linnar, ii. Theil (Wien, Gerold).—American Journal of Science, June (New Haven).—Sechster Jahres-Bericht des Sonnenblick-Vereins für das Jahr 1898 (Wien).—Himmel und Erde, June (Berlin).—Bulletin de la Société Impériale des Naturalistes de Moscou, 1897, No. 4 (Moscow).—Journal of the Institution of Electrical Engineers, June (Spon).—Brain, Part 81 (Macmillan).

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